

C7. CHAPTER 7 LIGHTNING PROTECTION

C7.1. POLICY

This chapter ~~defines~~*provides the* minimum explosives safety criteria for the design, maintenance, *installation*, testing, and inspection of Lightning Protection Systems (LPS) *and the training requirements for personnel conducting LPS maintenance, inspection, and testing. If other LPS for these facilities are used, they shall offer equivalent protection to the types prescribed herein. The Department of Defense has selected the LPS criteria of NFPA 780 (Reference (n)), as modified herein, including Annex K (Protection of Structures Housing Explosive Materials), Annex D (Inspection and Maintenance of Lightning Protection Systems), and Annex E (Ground Measurement Techniques) for AE facilities. Reference (n) shall apply regardless of any statements of nonapplicability contained within Reference (n). Annex criteria shall supersede main body criteria.* Properly maintained LPS are required ~~(with exceptions)~~for AE facilities.

C7.2. LPS DESIGN *AND INSTALLATION*

LPS used to protect DoD AE must be designed and installed using the rolling sphere method with a radius of 100 feet [30.5 m] or less IAW Annex K of Reference (n).

~~—C7.2.1. Design and installation of an LPS used to protect DoD AE must meet, at a minimum, the requirements of NFPA 780 Lightning Protection Code (Reference (m)). LPS must feature air terminals, low impedance paths to ground, sideflash protection, surge suppression or grounding of all conductive penetrations into the protected area, and earth electrode systems. Structural elements of the building may serve as air terminals, down conductors, or the earth electrode. LPS used to protect DoD AE must be designed to intercept lightning at a 100 ft [30.5 m] or less striking distance are in accordance with Reference (m).~~

~~——C7.2.1.1. Air Terminals. An air terminal is a component of an LPS that is able to safely intercept lightning strikes. Air terminals may include overhead wires or grids, vertical spikes, or a building's grounded structural elements. Air terminals must be capable of safely conducting a lightning strike.~~

~~——C7.2.1.2. Down Conductors. Down conductors (flat or round) provide low impedance paths from the air terminals to the earth electrode (ground) system. Structural elements having a high current capacity and a low impedance to ground need not be augmented with wires. Where wires are used as down conductors, these shall meet the requirements of Reference (m).~~

C7.2.1.3. Sideflash Protection. Protection from sideflash caused by lightning shall be obtained by either separation distance or bonding in accordance with Reference (m), ~~except as modified herein.~~ *In addition, fences and railroad tracks located within 6 feet [1.9 m] of a structure's LPS shall be bonded to the structure's LPS.*

~~—————C7.2.1.3.1. Fences and railroad tracks located within six feet of a structure's LPS shall be bonded to the structure's LPS.~~

~~—————C7.2.1.3.2. The reinforcing bars in adjacent structural elements must be joined in a manner to provide electrical bonding between the elements. This is an absolute requirement for facilities that are used to store AE. Techniques commonly used and approved in the construction industry to join reinforcing steel are acceptable for this purpose. The steel arch of an ECM must be similarly joined to the rebar in the floor.~~

~~—————C7.2.1.4. Surge Protection for Incoming Conductors. An LPS shall include surge protection for all incoming conductors. The surge protection must include suppression at the entrance to the building from each wire to ground. Shielded cabling, power cabling, communication lines, and electrical conduit shall be buried underground in conduit for a minimum of 50 feet [15.3 m] before entering the structure. All other metallic utility lines and pipes must be electrically connected to the LPS or the structural steel of the building just before they enter the building.~~

C7.2.2. Underground Storage Facility. An underground storage site ~~normally requires designed~~ protection against lightning only for exposed or partially exposed parts. ~~Metal and structural parts of the site that have less than 2 feet [60 cm] of earth cover shall be protected as for an aboveground site.~~ Lightning protection requirements shall be considered on a site-specific basis.

C7.2.1.5.3. Earth Electrode System. Earth electrode systems dissipate the current from a lightning strike to ground. Earth electrode systems may be ~~Ufer grounds~~ *concrete-encased electrodes*, ground loop conductors, radials, grounding rods, ground plates, a ~~cable~~ *conductor* immersed in nearby salt water, chemical grounds that are installed for the purpose of providing electrical contact with the earth, or combinations of these.

C7.2.4. Surge Protection. Surge protection devices shall be installed, IAW Reference (n), at all points where electrical or electronic system conductors enter or exit an AE facility.

C7.2.5. Underground Storage Facilities. An underground storage site only requires protection against lightning for exposed or partially exposed parts. Lightning protection requirements shall be considered on a site-specific basis.

C7.3. INSPECTION, TESTING, ~~AND~~ TRAINING, ~~AND~~ MAINTENANCE

C7.3.1. Visual Inspection. LPS shall be periodically inspected at a frequency determined by each DoD Component. ~~Visual inspections shall be conducted at least yearly. The maximum interval between LPS visual inspections shall be 1 year or an interval determined by a continuously validating statistical model determined by the DoD Component and approved by the DDESB.~~

C7.3.2. Electrical Tests. ~~LPS shall be periodically tested electrically as specified in subparagraphs C7.3.2.1. and C7.3.2.2. Electrical testing shall be accomplished at least every 2 years. LPS shall be electrically tested when placing a new facility into service and after any facility modification that may have affected the system. The maximum interval between LPS electrical testing shall be 2 years or an interval determined by a continuously validating statistical model determined by the DoD Component and approved by the DDESB. LPS shall be tested IAW Annex D of Reference (n), and shall meet the values specified in paragraphs C7.3.2.1. and C7.3.2.2.~~

C7.3.2.1. Bonding (Resistance) Tests. ~~Bonding (resistance) tests shall be conducted periodically (or after facility modification that may affect bonding).~~ A maximum resistance value of ~~one~~ 1ohm is permitted across ~~all~~ each bonds.

C7.3.2.2. Resistance to Earth Electrode Tests. ~~Resistance to earth tests of LPS shall be conducted periodically during the same season of the year (or after facility modification that may have affected the system). The maximum resistance to earth shall not exceed 25 ohms. The DoD Components shall establish guidance for situations (e.g., lack of top soil, desert conditions) where the maximum resistance cannot be met.~~

C7.3.2.3. Test Equipment. Test instruments shall be in good working order and calibrated IAW manufacturer's recommendations.

C7.3.3. Records and Data. Records ~~and test measurement data~~ of resistance to earth tests ~~and bonding tests~~ shall be kept on file for the last six inspection cycles. ~~These records shall be reviewed for trend analysis.~~

C7.3.4. Training. ~~Personnel responsible for maintenance, inspection, and testing must be familiar with the fundamentals described in Reference (m) and herein as they relate to AE facilities to ensure requirements of paragraphs C7.3.1. and C7.3.2. are met. Each DoD Component shall establish training requirements for personnel conducting LPS maintenance, inspection, and testing for AE facilities.~~

C7.3.5. Maintenance. Maintenance shall be performed to ensure that the integrity of the LPS conforms with the criteria of Reference (n).

C7.4. LIGHTNING PROTECTION EXCEPTIONS

~~Properly maintained LPS are required for AE facilities, with the follow e~~Exceptions to the LPS criteria in sections C7.1. through C7.3 are:

C7.4.1. ~~LPS is not required if these conditions are met:~~

C7.4.1.1. Explosives ~~operations~~ facilities that are served by an approved local lightning warning system (as determined by each DoD Component) that permit AE operations to be terminated before ~~the incidence of an electrical storm, if all personnel are provided with~~

~~protection equivalent to PTRD, and the damage from a lightning strike is acceptable to the DoD Component~~ if a thunderstorm is within 10 miles [16 km] of the installation.

C7.4.1.2. All personnel are evacuated to a shelter providing protection equivalent to PTRD.

C7.4.1.3. The resulting damage and loss from a lightning strike is acceptable to the DoD Component.

C7.4.2. *LPS is not required for F* facilities containing only AE that cannot be initiated by lightning, as determined by the DoD Component concerned and approved by DDESB, and where no fire hazard exists.

C7.4.3. LPS is not required for F facilities where personnel are not expected to sustain injury and at the same time, the resulting economic loss of the structure, its contents, and/or surrounding facilities is ~~minimal~~ acceptable to the DoD Component.

C7.4.4. The DoD Components shall establish guidance when airfield or flightline criteria conflicts with LPS requirements.

C7.4.5. ECMs that constitute a metallic cage, as defined in Annex K of Reference (n), and that do not contain any energized or unbonded metallic penetrations, do not require earth resistance testing.

C7.4.6. Large catenary systems that cannot conform to the bonding distances calculated from the equations provided in Reference (n) shall be considered under the alternate lightning protection systems in paragraph C7.5. Engineering analyses shall be provided to ensure that variances from Reference (n) provide equivalent protection. The DoD Components shall validate engineering analyses prior to submitting to DDESB for approval.

C7.5 ALTERNATE LIGHTNING PROTECTION SYSTEMS

If other LPS for AE facilities are used, they shall offer equivalent protection. The DDESB must approve use of nonstandard lightning protection schemes or nonstandard lightning protection test methods that provide equivalent protection.